

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (original) An apparatus for determining a threshold cycle number in a nucleic acid amplification reaction, the apparatus comprising:
 - a) a detection mechanism for measuring, at a plurality of different times during the amplification reaction, at least one signal whose intensity is related to the quantity of a nucleic acid sequence being amplified in the reaction; and
 - b) a controller in communication with the detection mechanism, wherein the controller is programmed to perform the steps of:
 - i) deriving a growth curve from the measurements of the signal;
 - ii) calculating a derivative of the growth curve;
 - iii) identifying a characteristic of the derivative; and
 - iv) determining a cycle number associated with the characteristic of the derivative.
2. (original) The apparatus of claim 1, wherein the controller is programmed to calculate a second derivative of the growth curve, and wherein the characteristic comprises a positive peak of the second derivative.
3. (original) The apparatus of claim 1, wherein the controller is programmed to calculate a second derivative of the growth curve, and wherein the characteristic comprises a negative peak of the second derivative.

4. (original) The apparatus of claim 1, wherein the controller is programmed to calculate a second derivative of the growth curve, and wherein the characteristic comprises a zero crossing of the second derivative.
5. (original) The apparatus of claim 1, wherein the controller is programmed to calculate a first derivative of the growth curve, and wherein the characteristic comprises a positive peak of the first derivative.
6. (original) The apparatus of claim 1, wherein the controller is programmed to calculate second derivative values of the growth curve at a number of different cycles in the reaction to yield a plurality of second derivative data points, the characteristic comprises a positive peak of the second derivative, and the controller is further programmed to determine the cycle number associated with the positive peak by:
 - i) fitting a second order curve to the second derivative data points; and
 - ii) calculating the cycle number as the location, in cycles, of a peak of the second order curve.
- 7-49. (cancelled)
50. (new claim) An apparatus for determining a threshold cycle number in a nucleic acid amplification reaction, the apparatus comprising:
 - a) at least one detection mechanism for measuring, at a plurality of different times during the amplification reaction, at least one signal whose intensity is related to the quantity of a nucleic acid sequence being amplified in the reaction; and
 - b) a controller in communication with the detection mechanism, wherein the controller is programmed to perform the steps of:
 - i) storing signal values defining a growth curve for the nucleic acid sequence, wherein the growth curve expresses signal intensity as a function of cycle number in the reaction;

- ii) determining a derivative of the growth curve, wherein the derivative is determined with respect to cycle number; and
- iii) calculating a cycle number associated with a characteristic of the derivative.

- 51. (new claim) The apparatus of claim 50, wherein the controller is further programmed to identify the characteristic of the derivative as the amplification reaction is occurring and to terminate the amplification reaction when the characteristic is identified.
- 52. (new claim) The apparatus of claim 50, wherein the controller is programmed to determine the second derivative of the growth curve, and wherein the cycle number is calculated as the location, in cycles, of a maximum of the second derivative.
- 53. (new claim) The apparatus of claim 50, wherein the controller is programmed to determine the second derivative of the growth curve, and wherein the cycle number is calculated as the location, in cycles, of a minimum of the second derivative.
- 54. (new claim) The apparatus of claim 50, wherein the controller is programmed to determine the second derivative of the growth curve, and wherein the cycle number is calculated as the location, in cycles, of a zero-crossing of the second derivative.
- 55. (new claim) The apparatus of claim 50, wherein the controller is programmed to determine the first derivative of the growth curve, and wherein the cycle number is calculated as the location, in cycles, of a maximum of the first derivative.

56. (new claim) The apparatus of claim 50, wherein the characteristic of the derivative comprises a maximum of the second derivative, and wherein the controller is programmed to perform steps (ii) and (iii) by:
calculating second derivative values of the growth curve, with respect to cycle number, at a number of different measurement points to yield a plurality of second derivative data points;
fitting a second curve to at least three of the second derivative data points; and
calculating the cycle number as the location, in cycles, of a positive peak of the second curve.
57. (new claim) The apparatus of claim 56, wherein the cycle number at the peak of the second curve is calculated using ratios of determinants, and wherein the determinants are calculated using the three second derivative data points.
58. (new claim) The apparatus of claim 50, wherein the characteristic of the derivative comprises a minimum of the second derivative, and wherein the controller is programmed to perform steps (ii) and (iii) by:
calculating second derivative values of the growth curve, with respect to cycle number, at a number of different measurement points to yield a plurality of second derivative data points;
fitting a second curve to at least three of the second derivative data points; and
calculating the cycle number as the location, in cycles, of a negative peak of the second curve.
59. (new claim) The apparatus of claim 58, wherein the cycle number at the peak of the second curve is calculated using ratios of determinants, and wherein the determinants are calculated using the three second derivative data points.

60. (new claim) The apparatus of claim 50, wherein the characteristic of the derivative comprises a maximum of the first derivative, and wherein the controller is programmed to perform steps (ii) and (iii) by:
calculating first derivative values of the growth curve, with respect to cycle number, at a number of different measurement points to yield a plurality of first derivative data points;
fitting a second curve to at least three of the first derivative data points; and
calculating the cycle number as the location, in cycles, of a peak of the second curve.
61. (new claim) The apparatus of claim 60, wherein the cycle number at the peak of the second curve is calculated using ratios of determinants, and wherein the determinants are calculated using the three first derivative data points.
62. (new claim) The apparatus of claim 50, wherein the characteristic of the derivative comprises a zero-crossing of the second derivative, and wherein the controller is programmed to perform steps (ii) and (iii) by:
calculating second derivative values of the growth curve at a number of different measurement points to yield a plurality of second derivative data points;
and
calculating the cycle number at the zero-crossing by interpolation between at least two of the second derivative data points.